

Lesson Plan: Catch It!

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Target Grade: 4th

Teacher Prep Time: 20 minutes

Lesson Time: 140 minutes (We recommend doing this lesson over 3 days)

- Part 1: 20 minutes – Beginning Thoughts About Phenomenon
- Part 2: 30 minutes – Planning the Investigation
- Part 3: 30 minutes – Carrying out the Investigation
- Part 4: 30 minutes – Analyzing Results
- Part 5: 30 minutes – Application

Lesson Overview:

Students will begin by discussing what happens when they see an object thrown toward them unexpectedly, and why they respond the way they do. Students will create an initial model explaining how the brain and other body systems work in response to this stimulation. Students will then plan and conduct an experiment to test how using different senses affects human “reaction time.”

Learning Objective(s):

- Students will be able to plan and carry out an investigation to determine how using one sense affects reaction time.
- Students will design a model to show how the nervous system detects and sends signals to the brain and carries signals back to produce a response.
- Students will be able to share their results and analyze their own data set as well as class data to draw a conclusion about how using different senses affects how fast the brain receives and processes information for a given stimulus.
- Students will be able to explain how different animals’ environments cause them to use a particular sense more in order to survive.

NGSS: 4-LS1-2 Use a model to describe that animals receive different types of information through their senses, process the information in their brain, and respond to the information in different ways.

- **Science and Engineering Practice**
 - #3 Planning and Carrying Out an Investigation
 - Planning and carrying out investigations to answer questions or test solutions to problems in 3-5 build on K-2 experiences and progresses to include investigations that control variables and provide evidence to support explanations or design solutions.
 - Plan and conduct an investigation collaboratively to produce data to serve as the basis for evidence, using fair tests in which variables are controlled and the number of trials considered.

- Make observations and/or measurements to produce data to serve as the basis for evidence for an explanation of a phenomenon.
- #2 Developing and Using Models
 - Modeling in 3-5 builds on K-2 experiences and progresses to building and revising simple models and using models to represent events and design solutions
 - Collaboratively develop and/or revise a model based on evidence that shows the relationships among variables for frequently and regular occurring events.
 - Develop and/use models to describe and/or predict.
- **Disciplinary Core Idea**
 - LS1.D: Information Processing
 - Different sense receptors are specialized for particular kinds of information, which may be then processed by the animal's brain. Animals are able to use their perceptions and memories to guide their actions.
- **Crosscutting Concept**
 - #2 Cause and Effect
 - In grades 3-5, students routinely identify and test causal relationships and use these relationships to explain change. They understand events that occur together with regularity might or might not signify a cause and effect relationship.

Where This Lesson Fits in:

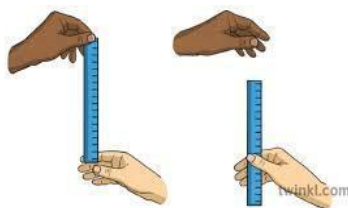
This lesson should be taught after students learn that animals have internal and external structures that function to support survival, growth, behavior, and reproduction (4-LS1-1).

Materials Needed:

- Fake rock or other soft object which appears hard
- Catch It! student worksheet (one per student)
- Blindfold (one per student)
- Ruler (one per group)
- Device that has internet and can be projected
- Document camera to model work for students

Teacher Prep:

- Group students in groups of three
- Select a student to throw the fake rock or object at and prep them for what will happen.
- Queue up video: [Ruler Drop Demonstration](#) (for Part 2)
- Ruler Drop Set-up



● **Lesson Sequence:**

*For this activity, we recommend that students work in groups of three.

Part 1 20 minutes	Beginning Thoughts on the Phenomenon ● Display fake rock for students to see; pretend it is very heavy. Quickly throw fake rock at a pre-selected student. ○ Expected Student Response (ESR) ■ Students will express surprise that the teacher threw the rock at a student. ● Distribute <i>Catch It!</i> student worksheet, read over question 1 as a class, then direct students to discuss the questions in their groups and record their ideas. ● After several minutes, ask one student from each group to share their ideas from their discussion. ○ ESR: (Accept any reasonable response.) ■ “Your eyes see the object coming at you.” ■ “You use your sense of sight or hearing as it comes toward you.” ■ “Your brain is telling you to catch the rock or to protect your face.” ■ “You throw your hands up to try to catch it or to block your face.” ● Tell students that scientists make models to explain a phenomenon, and that one type of model is a drawing. ● Direct students to make a drawing showing what happens as a person reacts when an object is thrown at them. Explain that they can incorporate their own ideas and also ideas they heard from the class discussion. ● Ask students to use arrows in their model to show how the brain and body are working together. ● Tell students to write an explanation of what they think is going on.
Part 2 30 minutes	Planning the Investigation ● Pose the question, “Do you think your reaction time would be different depending on which sense you were using? Why?” ● Call on students to share their ideas. Make sure students explain their thinking. ● Tell students that since no one knew the answer to the question maybe we will be able to determine it by performing an experiment. ● Have students suggest words to fill in the sentence frame so they will be able to design an experiment to find the answer. Guide them to the following: “If we change the <u>sense used</u>, what will happen to the <u>time it takes to react</u>?” Have students record on their worksheets.

	● Ask students how we could measure reaction time. Students will likely suggest using a stopwatch or timer. Let them know you don't have enough for the class and ask them what is in the classroom that is used for measuring. ○ ESR: A ruler ● Ask, "Could we use the ruler in place of the rock, and also to measure reaction time?" Guide students to the idea of dropping the ruler and seeing how fast they can catch it. ● Show students Ruler Drop Demonstration Video (https://www.youtube.com/watch?v=7PXxHsI29cQ). Emphasize that the smaller the number on the ruler, the faster the reaction time! ● Explain to students, "We are going to design and conduct an investigation to determine if the sense used affects the time it takes a person to react, which we call 'reaction time.'" ● Ask students what sense was used in the video, then ask what other sense they could test. Guide students to include touch and hearing as well as sight. Point out that sight, hearing, and touch will be the changing variables in the investigation. ● Explain that students will work in groups of three to conduct their investigation and collect data. Tell students they will decide which sense their group will test. Note: You may need to persuade groups to choose a particular sense to make sure all three senses are tested in the class. ● Guide students to fill out the Experimental Set-Up (see attached <i>Catch It!</i> worksheet example at end of lesson). ● When writing the procedure, have students tell you what information should be in each step, have another student act it out. Then have a third student put it into a sentence. Write this for the step. Then have students write the step with their own information in their worksheets. Student steps and the example step will be slightly different. Do this in a step by step approach and do not let students go ahead. ○ Step 1: Information about how catcher will get set-up ○ Step 2: Information about where the dropper will place the ruler. ○ Step 3: Information about the drop ○ Step 4: Information about the catch ○ Step 5: Information about what the recorder does ○ Step 6: Information about repeating the process. ● Have students write their prediction. ● Have a class discussion about which sense students think will be the fastest and why they think some students might have faster response rates than others.
Part 3 30 minutes	Carrying Out the Investigation ● Review with students how they will complete the Results Table on page 3 of the student worksheet. Remind students that data includes observations and measurements and that they are collecting measurement data in this investigation. ● Review how to calculate the median of data.

	● Distribute blindfolds and a ruler with centimeters to each group. ● Have students carry out investigations and record data. Note: Help students as needed to find the group median of their data.
Part 4 30 minutes	Analyzing Results ● Tell students they are going to report their data to the class, and everyone will record the data on the Class Results Table (worksheet page 5). ● Ask each group in turn to report their data. Record data and project it as you write so students can fill in the Class Results Table on their worksheet. ● Ask students why the measurement data was always greater than 1 cm. In other words, why is there any reaction time at all? After discussion, have students record their ideas in question 3. ○ ESR: It takes time for the catcher’s eyes/ears/hand to sense that the ruler has dropped, for that information to travel to the brain, and then for the brain to relay that information to the catcher’s hand to react. ● Give students time to revise their initial model with a different color pencil so the model reflects how their thinking changed. ● Ask students if all of their times for the trial in which they were the catcher were the same, and if not why the measurements might be different. After a class discussion have them fill in question 5. ○ ESR: ● Distracted, got better with practice, squeezed too early ● Ask students, “What did our experiment show? Was reaction time the shortest when we used our sight, hearing, or touch? If we wanted to have the fastest reaction time, which sense would we use?” ○ ESR: (Accept any response that is supported by the class data) ● “Reaction time was shortest when we used hearing. If we wanted to have the fastest reaction time, we would use hearing.” Note: Many factors affect reaction time so results can differ; however auditory signals are processed faster than visual signals based on brain studies. ● Guide students in writing the Results Summary for the investigation (see student worksheet sample). Be sure they make a statement and include the supporting data. ● Ask students, “What effect did wearing a blindfold have on your ability to respond?” ○ ESR: ● “Wearing a blindfold made it harder/easier to react.” ● Ask students, “Which sense do you think humans rely the most on to respond? Why?” After having a class discussion, have students fill out question 6. ○ ESR: ● Sight, because we have an atmosphere we can see through easily. ● Our eyes have structures that help us see well.

Part 5 10 minutes	Application ● Ask students, “ Do all animals use their senses of sight, hearing, smell, touch, and taste the same way humans do?” Have them discuss this in their table group. ● Ask students to share their ideas with the class. ● Tell students they are going to watch a two part video and after each part, they will complete the chart on page 7 explaining what causes different animals to use a particular sense more. ● Have students watch the video: Amazing Animals: Animal Senses Part 1 and 2 ○ Part 1: https://www.youtube.com/watch?v=kB-7IsuZ8Ic ○ Part 2: https://www.youtube.com/watch?v=rGd5oKqzp1Y ● Review student answers and discuss as needed. Students should conclude that the senses used help the organism interpret the world around them and help the organism to survive.
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Extensions:

Literature Connection: Amazing Animal Senses, by John Townsend

Example Student Work:

Name: _____

Catch It!

What Variables Affect a Human's Reaction Time?

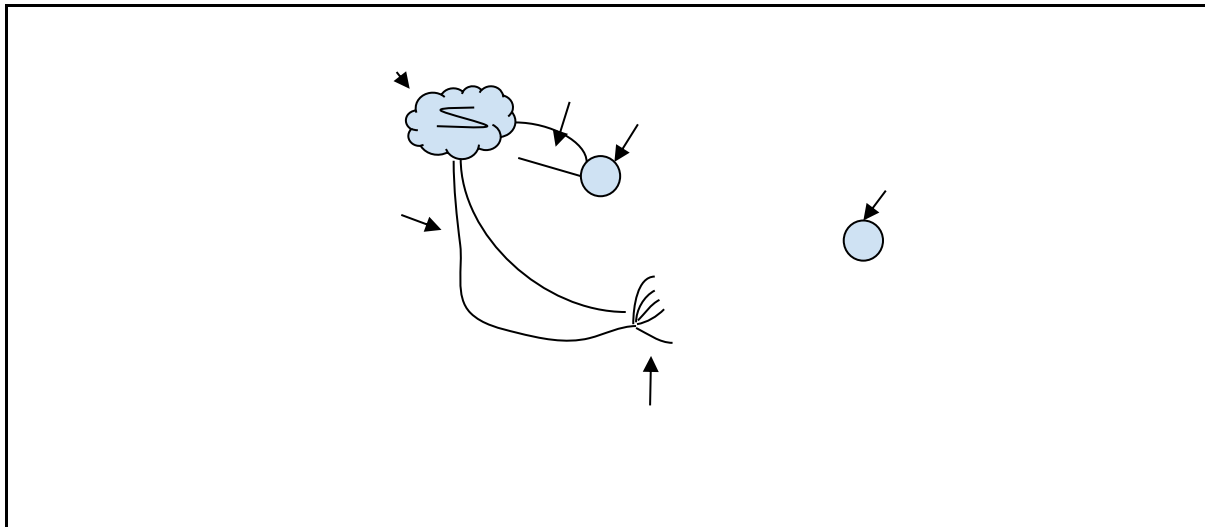
Part 1:

Beginning Thoughts on the Phenomenon

1. Discuss in your table group: What happens when you react to an object being thrown at you? What senses are you using? What is happening in your brain? The rest of your body? Jot down your ideas.

When an object is thrown at you, your eyes send a signal to your brain to tell your hands to catch the object so you don't get hit with the object. You use your sense of sight and your sense of touch to catch the object. Your brain thinks about whether you should do nothing, run away, or try to catch the object. The rest of your body does what the brain tells it to do.

2. Make an initial model to explain your thinking about what happens in your brain and your body when you react to an object that is thrown at you. Then explain your thinking below.



My picture shows that when your eye sees the ball coming, it sends a signal to the brain that the ball is coming. The brain then has to decide whether you should try and catch the ball, run away, or do something else. If the brain decides you should catch the ball, it will send a signal to your hand to try and catch the ball.

Part 2: Planning the Investigation

QUESTION

If we change the sense we use, what will happen to the time it takes to react (reaction time)?

EXPERIMENTAL SET-UP

Changing Variable:
(Check One)

- ☒ Sight (no blindfold)
- ☐ Hearing (blindfold)
- ☐ Touch (blindfold)

Controls:

Object type: ruler

Ruler length (cm): 30 cm

Starting position: 1 cm

Number of drops: 3

Note: The catcher can't move until they *see* the ruler drop or *hear* the word "drop."

PROCEDURE

1. Catcher sits in chair and rests catching arm on desk with hand extended slightly beyond desk.
2. Dropper positions the ruler so the catcher's fingers are located at the 1 cm mark, but not grasping the ruler.
3. If the changing variable is sight, skip to step 5; if your changing variable is hearing or touch, put blindfold on catcher.
4. If the changing variable is hearing, dropper will say "Go" as they drop the ruler. If the changing variable is touch, the catcher will place their non-catching hand on top of the dropper's hand in order to feel when the ruler is dropped.
5. Dropper drops the ruler and catcher catches as quickly as possible.
6. Record the centimeter number immediately above the catcher's index finger.
7. Repeat two more times

Predictions:

I predict that using the sense of sight will cause a quicker reaction than the senses of hearing and touch.

I predict that different people will have different times when testing the same sense because some people have quicker reflexes than others.

Part 2: Carrying Out the Investigation

RESULTS
Table

Changing Variable: Hearing

	<i>Measurements on Ruler (cm)</i>		
<i>Drop #</i>	<i>Student 1</i>	<i>Student 2</i>	<i>Student 3</i>
<i>1</i>	<i>24</i>	<i>36</i>	<i>22</i>
<i>2</i>	<i>22</i>	<i>28</i>	<i>25</i>
<i>3</i>	<i>25</i>	<i>25</i>	<i>23</i>
<i>Put lengths in order:</i>	<i>22, 24, 25</i>	<i>25, 28, 36</i>	<i>22, 23, 25</i>
<i>Median:</i>	<i>24</i>	<i>28</i>	<i>23</i>
<i>Put medians in order:</i>	<i>23, 24, 28</i>		
<i>Group Median:</i>	<i>24</i>		

Analyzing Results

CLASS RESULTS

Table (cm)

	Median Measurement		
Group	Hearing	Touch	Sight
1	16		
2	18		
3		24	
4		36	
5		22	
6			31
7			25
8	20		28
Order data:	16, 18, 20	22, 24, 36	25, 28, 31
Median:	18	24	28

3. Why were the measurements always greater than 1 cm?

It takes time for the eyes, ears, and hand to see, hear, or feel the ruler drop, for the nerves to send a signal to the brain, and then for the brain to tell the catcher's hand to catch the ruler.

4. Revise your model as needed to show your thinking, using a different colored pencil.

5. Were the measurements the same for all of your trials when you were the catcher? Yes No If no, what things might have happened that affected your measurements?

Cause:	Effect on Response (circle one):
1. The ruler could be tilted to one side or not completely straight	<u>longer</u> / shorter

2. Some catchers might have quicker reflexes.	longer / <u>shorter</u>
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RESULTS

Summary

Our class experiment shows our reaction time is different depending on the sense we use. Using only our sense of hearing resulted in our shortest reaction time. Using only the sense of sight resulted in a slower reaction time, because the median catch measurement was 18 cm, but the median catch measurement was 28 cm.

6. Think about how we react when an object is thrown at us. Which sense do you think we rely on the most to respond? Why?

We rely mostly on our sense of sight because we are used to always using our eyes to see what is around us. Our atmosphere usually allows us to see clearly. We may not be able to hear or feel something being thrown at us, but we can see it. Also, our eyes are able to send more detailed information to our brain than sound. For instance, we can tell the size, shape, and relative speed of the object as it is coming toward us.

Application

7. Other animals may rely more on other senses in order to survive in their environment. For each of the animals listed, tell which sense you think is most important for their survival and explain why.

Animal	Sense	What about their environment caused them to use this sense?
Part 1: lion	<i>sight</i>	<i>Lions hunt in grasslands which makes it hard to hide so lions need to see their prey from a distance.</i>
coati	<i>smell</i>	<i>Coati use their sense of smell to locate turtle eggs buried in the sand.</i>
raccoon	<i>touch</i>	<i>Racoons find their food in shallow waters and use their sensitive pads on their paws to search for their prey in water.</i>
Part 2: salamander	<i>taste</i>	The salamander tracks slugs by licking its slime trail.
Boto dolphin	<i>hearing</i>	<i>Dolphins use echolocation to find fish because it is hard to see in murky water, but sound travels well.</i>

Content Notes for Teachers:

According to the most recent research, the sound stimulus produces the quickest response with the sense of touch just slightly slower (about 40 msec). MRI tests show it takes longer for visual information to be processed by the brain than auditory information. However, the difference between sound, touch, and visual responses is only about 40 to 100 milliseconds. Therefore, variances in the ruler drop test procedure may lead to different results. Additionally, factors such as the catcher's age, gender, experience, and even the color of the ruler have been shown to be variables which can impact results.

One pattern that should be observed is that, as a given student repeats the ruler trials, their time will improve until fatigue sets. This is because when we acquire a new physical skill through repetition, our nervous system creates new neural pathways. The neural pathways (eye, brain, muscles) become better connected leading to higher efficiency. This is commonly referred to as *muscle memory*.

The steps to reaction to an incoming ball for visual stimuli is the following:

1. Ball approaches
2. Eyes register light reflecting from the ball and sends information to the Occipital Lobe
3. The Occipital Lobe sends visual information to the Frontal Lobe
4. The Frontal Lobe decides how to respond.
5. The Frontal Lobe sends instructions to the Motor Cortex
6. The Motor Cortex sends signals through the spinal cord to the hands, etc.
7. The hands enact the response.

References:

[Factors Affecting Reaction Time Scientific Journal Reviews](#)